George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

QD-A-003
REVISION: B
Released DATE: December 6, 2004

ORGANIZATIONAL INSTRUCTION

Professional Development Roadmap (PDRM) for Reliability and Maintainability Engineers

OPR(s)	OPR DESIGNEE
All QD Departments	Prince Kalia

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline	Baseline	03/03/04	New Document
	A	10/15/04	Revised to bring this document in compliance with the HQ Rules Review Action (CAITS: 04-DA01-0387). Changes made to reflect inputs from R&M Team members and key member of SMO to substitute some college based courses to short duration training programs and moved certain college to next expertise level and deleted college level simulation course work.
	B	12/6/04	Administrative change – removed Apprentice as a qualification

Professional Development Roadmap for S&MA Reliability and Maintainability Engineers

1. PURPOSE, SCOPE, APPLICABILITY

1.1. Purpose – The purpose of this Organizational Instruction (OI) is to establish a voluntary training and development roadmap for Reliability and Maintainability Engineers within the Marshall Space Flight Center (MSFC) Safety and Mission Assurance (S&MA) Directorate. This OI identifies the minimum level of training, knowledge and skills that MSFC S&MA Reliability and Maintainability Engineers shall acquire in developing their engineering discipline expertise.

1.2. Scope – This OI shall serve as a development roadmap for Reliability and Maintainability Engineers who support MSFC programs and projects. It provides a comprehensive list of training, knowledge requirements and on-the-job (OJT) experience needed by MSFC S&MA Reliability and Maintainability Engineers to effectively execute their duties.

This roadmap establishes three qualification levels (Novice, Journeyman and Expert), and provides a process for progressive qualification at each level.

This roadmap shall be used in conjunction with Individual Development Plans (IDP) to encourage reliability and maintainability specialists to pursue development activities most appropriate to their specialty. The intent is to use the roadmap to guide the development of IDPs for S&MA Reliability and Maintainability Engineers.

1.3. Applicability – This OI applies to all MSFC S&MA personnel who seek to provide MSFC S&MA Reliability and Maintainability Engineering services, both in-house and off site, and who choose to participate. Mission support contractor personnel are also encouraged to participate in this voluntary program (or in a tailored mission support contractor program approved by the S&MA Director).

Personnel shall satisfy the prerequisites specified in this OI before participating in this roadmap process.

2. DOCUMENTS

2.1. Applicable Documents

2.1.1 MPG 3410.1 Training
2.1.2 MWI 3410.1 Personnel Qualification Program
2.1.3 Individual Development Plan Instruction (Being revised)

2.2 Reference Documents

2.2.1 Organizational Instruction: Professional Development Roadmap (PDRM) for System Safety Engineers, Safety and Mission Assurance, Marshall Space Flight Center.

2.2.2 Organizational Instruction: Professional Development Roadmap (PDRM) for Quality Engineers, Safety and Mission Assurance, Marshall Space Flight Center.

3. DEFINITIONS AND ACCRONYMS

3.1 The Professional Development Roadmap (PDRM) identifies and documents the minimum training, knowledge requirements and on-the-job (OJT) experience needed by MSFC S&MA personnel at three levels of their discipline expertise development.

3.2 Individual Development Plan (IDP) – is a document developed jointly by the employee and supervisor to plan the employee's training and development needs as well as to identify possible training solutions. The plan shall focus on immediate and short-term goals that are in line with the longer-term goals of both the employee and the organization.

3.3 Qualification – the act of verifying and documenting that personnel have completed required training, and have demonstrated specified proficiency.

3.4 Qualification levels – are defined as:

- Novice: The lowest recognizable level (Appendix A).
- Journeyman: Intermediate level of expertise (Appendix B).
- Expert: The highest level of expertise (Appendix C).

3.5 Qualification Criteria – are specified in Appendix A (Novice), Appendix B (Journeyman) and Appendix C (Expert) and include three categories of accomplishments that demonstrate discipline expertise:

- Training – traditional, online and computer based.
- Reference documents – demonstrating understanding.
- On the Job training (OJT) – demonstrating specific skills.

3.6 Prerequisites – that shall be satisfied prior to becoming an Apprentice and participating in the PDRM process are specified in Appendix A.

3.7 Application for Qualification: - shall be submitted by the candidate seeking qualification at the completion of the requirements at each level. Application consists of:

- Completed and approved application Form (Appendix D).
- Completed and approved copy of Appendix A, (for Novice qualification), Appendix B (for Journeyman qualification) or Appendix C (for Expert qualification).

3.8 Implementation requirements – are specific actions required to initially implement this OI. (See section 4.1).

3.9 Qualification of Experienced Personnel – may be earned by documenting candidate's previously completed training and development. (See section 4.3).

3.10 Qualification by Designation (Grandfathering) – is qualification prior to completion of the required PDRM line items. This shall be done only during initial process implementation stages to create discipline Champion and Mentors. Personnel qualified in this manner are expected to document their qualifications as soon as possible thereafter. (See section 4.4).

3.11 Equivalent Training Criteria – are classes or experiences that may be substituted for those specified in the Appendices. During initial stages of the program, or when new employees are transferred into S&MA, previously completed items may be substituted with approval of the Champion. Thereafter, the Champion shall approve all equivalent criteria in advance.

3.12 Personnel and Roles – required to implement this OI are defined below:

3.12.1 Candidate – is an employee or mission support contractor who seeks qualification via the PDRM process.

3.12.2 Supervisor – the organizational line manager who provides supervisory functions and responsibilities for employee positions requiring training and/or qualification. The supervisor helps create, and approves, the candidate's IDP, verifies completion of the OJT requirements, and recommends the candidate for qualification.

3.12.3 Mentor – is an experienced Reliability/Maintainability Engineer who is selected as, and who agrees to perform as, a coach to the candidate in the PDRM qualification process. Mentors are also responsible for verifying candidate's understanding of the required reference documents.

Mentors are normally required to be qualified at least at the Journeyman Level (Expert level if mentoring a candidate for Expert qualification).

A Reliability/Maintainability Engineer who does not meet the qualification requirement, but who has extensive and relevant experience, may be approved to serve as Mentor on a case-by-case basis. This exception requires approval by the candidate's supervisor and the discipline Champion.

3.12.4 Reliability/Maintainability Champion – is an individual recognized as a key leader in the S&MA Reliability and Maintainability discipline, and is designated by the S&MA Director (or his/her designee). The Champion is responsible for technical content of this PDRM, approval of any "equivalent" criteria, selecting and training Mentors, and participation in the Qualification

Review Board.

3.12.5 Qualification Review Board – is responsible for reviewing and approving qualification applications. The Board shall consist of the S&MA Director (or his/her designee), the discipline Champion, and others selected by the S&MA Director. The Board shall also review and approve any changes to this OI.

3.13 PDRM Designation Memorandum – a document signed by the Director of S&MA that identifies S&MA personnel who are authorized to serve as discipline Champion, Mentors and Qualification Review Board members.

4. INSTRUCTIONS

4.1 Implementation Requirements – Implementation of this OI shall begin upon approval by the S&MA Director, and shall require the following additional actions:

- Selecting the Reliability and Maintainability Engineering discipline Champion, and designating (grandfathering) him/her to be qualified at the Expert level.

- Selecting Reliability and Maintainability discipline Mentors, and designating (grandfathering) them to be qualified at the Journeyman or Expert level.

- Appointing Qualification Review Board Members.

- Publishing the PDRM Designation Memorandum.

- Authorizing and initiating a work task for the Champion and/or Mentors to prepare a set of checklists and sample questions to be used as guidelines for demonstrating candidate knowledge of the reference documents.

- Formalizing and baselining the in-house courses identified in the appendices that are currently taught informally by NASA employees and mission support contractors

- Communicating to all personnel of the existence, purpose, expectations, process and names of key personnel associated with this OI.

4.2 Qualification Process (Normal) - A candidate seeking qualification shall use the following process. This process is further illustrated in the flow chart in Section 11.

4.2.1 Candidate declares S&MA specialty as Reliability and Maintainability Engineer. Supervisor approves.

4.2.2 Candidate documents completion of prerequisites using a completed copy of the application form (Appendix D). The candidate becomes an Apprentice.

4.2.3 Supervisor seeks/assigns Mentor (with support from the discipline Champion).

4.2.4 Apprentice works with Supervisor to develop an IDP containing appropriate items from the PDRM (Appendix A).

4.2.5 Apprentice pursues the required developmental activities per the PDRM and IDP.

4.2.6 Upon completion of each developmental activity, the Apprentice obtains the proper signature on the PDRM (Appendix A) as shown in the following table:

Criteria Type	**Required Activity**	**Verifying Signature**
Training Classes	Complete successfully	Supervisor
Reference Documents	Demonstrate understanding	Mentor
OJT Experiences	Complete successfully	Supervisor

4.2.7 Upon completion and documentation of all required activities for qualification, Apprentice completes the application form, obtains signature from the discipline Champion and submits completed package to his/her Supervisor.

4.2.8 Supervisor signs the application and forwards it to the S&MA Director for action by the Qualification Review Board.

4.2.9 The Qualification Review Board reviews the application, and makes the approval decision.

4.2.10 A Novice may earn Journeyman qualification by continuing the above process using Appendix B.

4.2.11 A Journeyman may earn Expert qualification by continuing the above process using Appendix C.

4.3 Qualification of Experienced Personnel - Existing S&MA personnel and new personnel hired/transferred into S&MA, who are experienced in the Reliability and Maintainability Engineering discipline, may seek qualification at any level for which they qualify by documenting their previously completed achievements and using the following process. This process is further illustrated in the flow chart in Section 11.

4.3.1 Candidate documents previously completed training classes and OJT achievements on the appropriate appendices (e.g. a candidate applying for Expert qualification shall complete Appendix A, B and C):

- Equivalent training and experiences may be substituted for the criteria specified in the appendices with the approval of the discipline Champion.

- The training department shall verify training classes. Candidates are responsible for providing proof (e.g. copies of certificates, grade reports and/or transcripts) of non-NASA training to the training department.

- OJT shall be verified by signature of the Supervisor.

4.3.2 Candidate shall demonstrate his/her understanding of the reference documents using the normal qualification process (See section 4.2).

4.3.3. Upon completion and documentation of all required activities for qualification, candidate completes the application form (Appendix D), obtains discipline Champion approval and submits the package to his/her Supervisor for approval.

4.3.4 Supervisor approves the application and forwards it to the Qualification Review Board for action.

4.3.5. The Qualification Review Board reviews the application and decides the qualification level to be granted.

4.4 Qualification by Designation (Grandfathering) – During the initial PDRM process implementation, the S&MA Director (or his/her designee) may qualify the discipline Champion and Mentors prior to their completion of the PDRM application. Any personnel so qualified are expected to document their qualifications per the PDRM process for experienced personnel (section 4.3) as soon as possible thereafter.

4.5 Maintaining Qualification - It is expected that personnel qualified at the Expert level shall (1) continue training (at least 40 hours per year in their discipline) and (2) continue to perform OJT activity at the level described in Appendix C.

4.6 Process Measurement - shall be accomplished by baselining the number of personnel qualified at each level, and thereafter measuring the progress toward qualification by S&MA personnel. The baseline shall be created 6 months after implementation. Measurements shall be made semi-annually thereafter. Each semi-annual measurement shall count the number of individuals qualified at each level, and estimate the progress (percent complete) of each participating individual toward the next level. Department Managers shall report this

measurement at the next scheduled monthly status review.

4.7 Amendments – Changes to this Organizational Instruction are made per the documented Organizational Instruction Change Process. The Qualification Review Board shall review proposed changes to this PDRM prior to submitting them to the MSFC Director of S&MA for approval. The custodial responsibility for this PDRM shall be assigned to the Safety, Reliability, and Quality Assurance Policy and Assessment Department (QD40).

5. NOTES

5.1. OI Replacement - None

6. SAFETY PRECAUTIONS AND WARNING NOTES

None

7. APPENDICES, DATA, REPORTS, AND FORMS

A – PDRM for Reliability & Maintainability Engineer: Novice
B – PDRM for Reliability & Maintainability Engineer: Journeyman
C – PDRM for Reliability & Maintainability Engineer: Expert
D – Qualification Application Form

8. RECORDS

Records	Repository	Period of Time
Completed PDRM (Official Course completion information shall be kept by the MSFC Training Office)	S&MA Training Officer	5 years (Documentation of the appropriate PDRM shall be kept by the MSFC Training Office.)

9. TOOLS, EQUIPMENT, AND MATERIALS

None

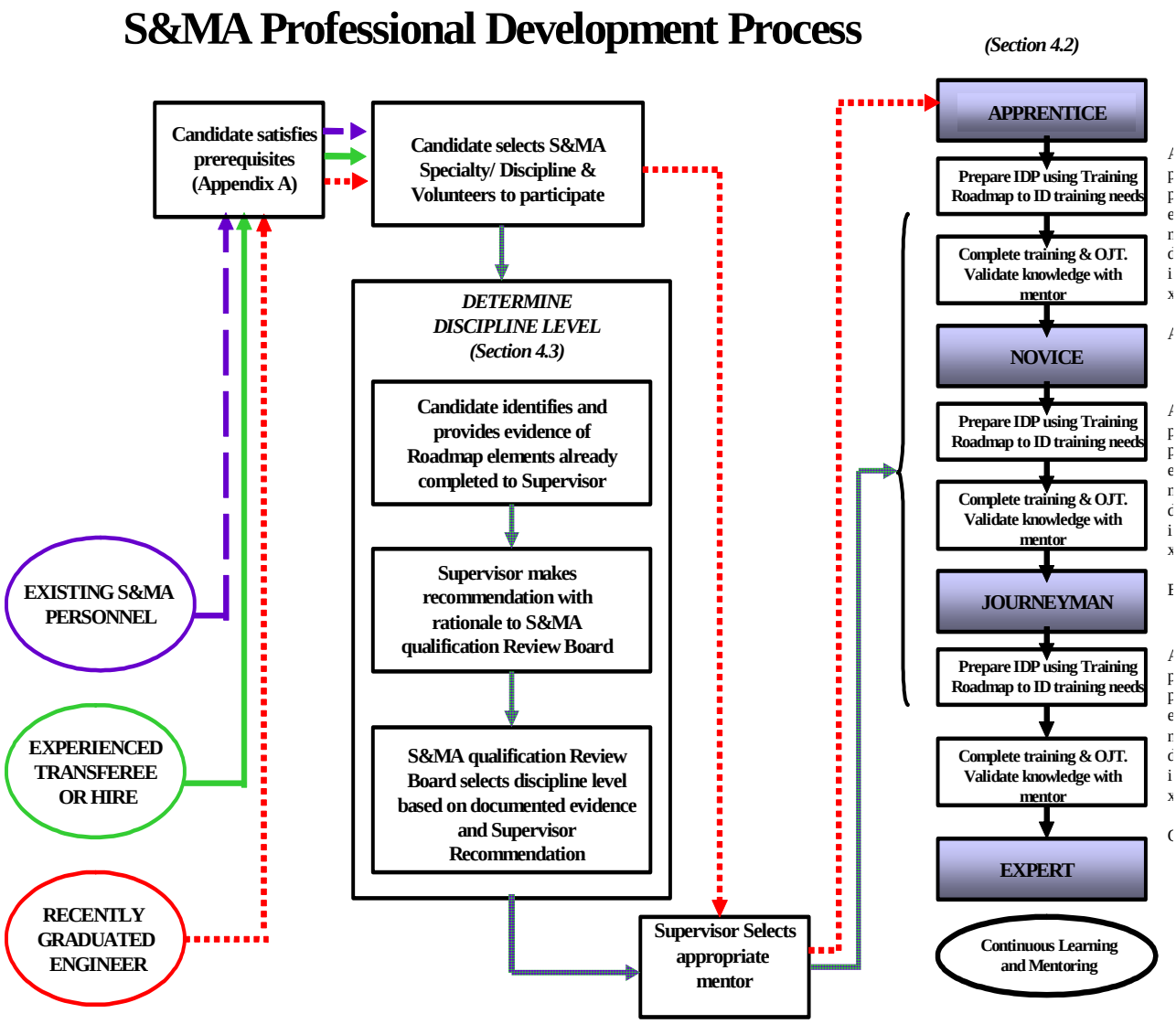
10. PERSONNEL TRAINING REQUIREMENTS

See Appendix A - C

11. FLOW DIAGRAM

The flow diagram (Figure 11-1) illustrates the PDRM qualification process described in this OI.

Figure 11-1



Notes:

1. Qualification Review Board is the decision authority for qualification levels and approvals.

APPENDIX A: PDRM for Reliability and Maintainability Engineers: NOVICE Qualification Requirements

A.1 Objective:

This Appendix provides the qualification criteria for Reliability/Maintainability Engineers to be qualified at the Novice level, using the process described in the body of the Organizational Instruction.

A.2 Prerequisites:

Prior to beginning the process, the candidate shall qualify as an Apprentice Reliability/Maintainability Engineer by satisfying the following prerequisites:

1. Candidate shall be an Aerospace Technology Professional (AST) with an appropriate engineering/scientific degree (chemical, electrical, electronic, industrial, mechanical, system, or equivalent)

2. Candidate shall volunteer to participate in the PDRM qualification program, declare his/her specialty as Reliability/Maintainability Engineer, and obtain approval of his/her immediate supervisor.

3. Candidate shall complete the S&MA Overview Orientation Class (currently a 4 hour MSFC internal class).

4. Candidate shall complete a program specific overview orientation class for the candidate's assigned program, including the S&MA aspects of that program.

5. Candidate shall be skilled in the use of the MS Office Suite including Word, Excel and PowerPoint, and shall show evidence of capability to make an effective presentation.

A.3 Experience:

Candidate shall have at least 1 to 3 years of relevant experience in the discipline prior to earning the Novice Qualification.

APPENDIX A: PDRM for Reliability and Maintainability Engineers: NOVICE Qualification Requirements

TRAINING CLASS REQUIREMENTS **Equivalent classes may be substituted with approval by the Discipline Champion. Sequence is suggested but not mandatory.**		**SIGNATURE/ DATE COMPLETE**
Design For Reliability & Maintainability DFR-101 & 201: In House class (4 hrs).		_____ _____ Signature Date
Foundations of Project Management: APPL class (4 days).		_____ _____ Signature Date
Electronic Design Reliability: RAC: http://rac.alionscience.com/rac (3 days).		_____ _____ Signature Date
Probability and Statistics Workshop/short duration training program		_____ _____ Signature Date
Failure Modes Effects Analysis & Critical Items List: - Solar: SMA-017-01 (1 hour estimated) - In House Component (Note 2), (4 hours).		_____ _____ Signature Date
Probabilistic Risk Assessment, NASA HQ sponsored course, (Annual Workshop).		_____ _____ Signature Date
Systems Management: APPL Class (4 days) plus: - Pre-class session at MSFC to discuss relevant questions regarding R&M role in systems engineering (led by champion) (2 hours) - Post class student feedback to the S&MA R&M team (2 to 4 hours).		_____ _____ Signature Date
Reference document workshops conducted informally on site by Champion and/or other in-house experts. (Note 2), (4 hours).		_____ _____ Signature Date

APPENDIX A: PDRM for Reliability and Maintainability Engineers: NOVICE Qualification Requirements

Microsoft Project-Introduction: MSFC Professional Development Class (2.5 days) OR MSFC video class, Building 4200 (Number TBD).		_____ _____ Signature Date
Influencing Others: MSFC Organizational Development Class (1 day).		_____ _____ Signature Date
Conflict Management: MSFC Professional Development Class (2 days).		_____ _____ Signature Date

Notes:

1. UAH = University of Alabama at Huntsville. Up to 12 credits may be earned without registering for degree. UAH class sequence shall be as shown in the table above.
2. Classes identified as "In-House" shall be formally registered with the Training Department.

APPENDIX A: PDRM for Reliability and Maintainability Engineers: NOVICE Qualification Requirements

REFERENCE MATERIALS **Demonstrate familiarity with key concepts as defined by the discipline champion**		**SIGNATURE/ DATE COMPLETE**
NPD 8720.1 NASA Reliability and Maintainability (R&M) Program Policy.		_____ _____ Signature date
NASA-STD-8729. Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program.		_____ _____ Signature date
MSFC-HDBK-3173: Project Management and Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
SP-6105: NASA Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
NASA Reference Publication 1358: Systems Engineering "Toolbox" for Design-Oriented Engineers (pages to be identified by Champion).		_____ _____ Signature date
NPG 8000.4: Risk Management Procedures and Guidelines.		_____ _____ Signature date
NSTS 22254: Methodology for Conduct of Space Shuttle Program Hazard Analysis.		_____ _____ Signature date
NSTS 22206 & SSP 30234: Instructions for Preparation of Failure Modes Effects Analysis and Critical Items List.		_____ _____ Signature date

Notes:
1. Discipline Champion is responsible for identifying specific level of understanding required (See section 4.1).

APPENDIX A: PDRM for Reliability and Maintainability Engineers: NOVICE Qualification Requirements

ON THE JOB TRAINING **Complete the following activities**		SUPERVISOR SIGNATURE/ DATE COMPLETE
Under appropriate supervision, observe/support completion of an R&M checklist in support of a NASA project or program.		_____ _____ Signature date
Under appropriate supervision, observe/support conduct of a FMEA/CIL in support of a NASA project or program and participate in problem analysis/resolution of in-flight anomaly (IFA) or acceptance test procedure (ATP) failure of flight hardware or payload line replaceable unit (LRU).		_____ _____ Signature date
Observe a team creating a fault tree in support of a NASA project or program.		_____ _____ Signature date
Observe/support at least one design review in support of a NASA project or program.		_____ _____ Signature date
Join and participate in relevant professional society (e.g. Society for Reliability Engineers) by attending meetings and participating in discussions and activities.		_____ _____ Signature date

Notes:

1. Candidate shall work with his/her Supervisor to identify specific applicable assignments. Discipline Champion may be consulted to ensure proposed assignment shall satisfy the qualification requirements.

APPENDIX B: PDRM for Reliability and Maintainability Engineers: JOURNEYMAN Qualification Requirements

B.1 Objective:

This Appendix provides the qualification criteria for Reliability/Maintainability Engineers to be qualified at the Journeyman level, using the process described in the body of the Organizational Instruction.

B.2 Prerequisites:

Prior to beginning the process, the candidate shall be qualified as a Novice Reliability/Maintainability Engineer per the requirements in Appendix A.

B.3 Years of Experience:

Candidate shall have at least 3 to 5 years of relevant experience in the discipline prior to being qualified at the Journeyman level.

APPENDIX B: PDRM for Reliability and Maintainability Engineers: JOURNEYMAN Qualification Requirements

TRAINING CLASS REQUIREMENTS **Equivalent classes may be substituted with approval by the Discipline Champion. Sequence is suggested but not mandatory**		**SIGNATURE/ DATE COMPLETE**
Statgraphics, introduction and advanced class combined; (3 days), Http://www.stratgraphics.com		_____ _____ Signature date
Statistical Methods for Engineers; (ISE 690 at UAH).		_____ _____ Signature date
Systems Requirements: NET Class (4 days).		_____ _____ Signature date
Extend: An Overview of Extend in Discrete Event Simulation; In-house class #TD-53, (Note 2), (4 hours).		_____ _____ Signature date
Introduction to Crystal Ball Simulation Tool; and Advanced Crystal Ball - combined class, (1 Day), http://www.crystalball.com		_____ _____ Signature date
Engineering Reliability: ISE 638 at UAH.		_____ _____ Signature date
Statistical Quality Control (SQC): ISE 523 at UAH.		_____ _____ Signature date
Relex Class by Relex Software, Inc.; (4 days) http://www.relexsoftware.com		_____ _____ Signature date
Environmental Stress Screening (ESS) Training Seminar, Screening Systems, Inc., Laguna Hills, CA (2 days).		_____ _____ Signature date
Leading from the Inside Out: MSFC Professional Development Class (2 days).		_____ _____ Signature date
Communicating For Results: MSFC Professional Development Class (2 days).		_____ _____ Signature date
Team Development in the Workplace: MSFC Organizational Development Class (3 days).		_____ _____ Signature date

Mentoring: MSFC Organizational Development Class (1 day). Suggested at end of qualification for Journeyman.		_____ _____ Signature date

Notes:

1. UAH = University of Alabama at Huntsville. Up to 12 credits may be earned without registering for degree. UAH class sequence shall be as shown in the table above.

3. Classes identified as "In-House" shall be formally registered with the Training Department.

APPENDIX B: PDRM for Reliability and Maintainability Engineers: JOURNEYMAN Qualification Requirements

REFERENCE MATERIALS **Demonstrate working knowledge with contents as defined by the Discipline Champion**		**MENTOR SIGNATURE/ DATE COMPLETE**
NSTS 07700 Program Definition and Requirements Documents – Volume 10; Specific sections to be identified by Champion.		_____ _____ Signature date
R&M MIL-STDs & Handbooks: To be defined by Champion: Basic content.		_____ _____ Signature date
MSFC-HDBK-3173: Project Management and Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
SP-6105: NASA Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
NASA Reference Publication 1358: Systems Engineering "Toolbox" for Design-Oriented Engineers (pages to be defined by Champion).		_____ _____ Signature date
Systems Engineering Tools Survey for R&M, SS and Quality: Link to RAC: http://rac.alionscience.com/rac/jsp/softtools/softtool.jsp		_____ _____ Signature date

Notes:
1. Discipline Champion is responsible for identifying specific level of understanding required (See section 4.1).

APPENDIX B: PDRM for Reliability and Maintainability Engineers: JOURNEYMAN Qualification Requirements

ON THE JOB TRAINING **Complete the following activities in any sequence**		**SUPERVISOR SIGNATURE/ DATE COMPLETE**
Complete (or contribute to a team completing) an R&M checklist in support of a NASA project or program.		_____ _____ Signature date
Conduct (or contribute to a team conducting) a FMEA/CIL in support of a NASA project or program.		_____ _____ Signature date
Support a team creating a fault tree in support of a NASA project or program.		_____ _____ Signature date
Perform (or participate on a team performing) at least two different types of design reviews in support of a NASA project or program.		_____ _____ Signature date
Contribute to relevant professional society (e.g.: Society of Reliability Engineers) activity via discussions, committee/sub-committee work or writing/presenting a paper.		_____ _____ Signature date
Participate in inter-program or inter-center coordinating activity to enhance MSDC and/or NASA expertise in your discipline.		_____ _____ Signature date
Work toward external professional qualification.		_____ _____ Signature date
Mentor other personnel in your discipline to help them improve their skills/expertise. This can be as a mentor to others in this PDRM process or as an informal coach in your daily work.		_____ _____ Signature date

Notes:
1. Candidate shall work with his/her supervisor to identify specific applicable assignments. Discipline Champion may be consulted to ensure proposed assignment shall satisfy the qualification requirements.

APPENDIX C: PDRM for Reliability and Maintainability Engineers: EXPERT Qualification Requirements

C.1 Objective:

This Appendix provides the qualification criteria for Reliability/Maintainability Engineers to be qualified at the Expert level, using the process described in the body of the Organizational Instruction.

C.2 Prerequisites:

Prior to beginning the process, the candidate shall be qualified as a Journeyman Reliability/Maintainability Engineer per the requirements of Appendix B.

C.3 Years of Experience:

The candidate shall have at least 8-10 years of relevant discipline experience prior to becoming qualified at the Expert Level.

APPENDIX C: PDRM for Reliability and Maintainability Engineers: EXPERT Qualification Requirements

TRAINING CLASS REQUIREMENTS **Equivalent classes may be substituted with approval by the Discipline Champion. Sequence is suggested but not mandatory**		**SIGNATURE/ DATE COMPLETE**
Comprehensive Systems Skills: NET Class (5 days).		_____ _____ Signature date
Advanced Statistical Applications: ISE 790 at UAH.		_____ _____ Signature date
Reliability, Availability and Maintainability; ISE 738 at UAH.		_____ _____ Signature date
Quality Assurance (Design of Experiments/ Taguchi Methods) - ISE 526 at UAH.		_____ _____ Signature date
Maintainability in Commercial Aircraft, Engine and Component Design: Course # AA41020, University of Kansas (3 days).		_____ _____ Signature date
Crossing Department Lines: NASA HQ Class, Agency leadership and Development programs (5 days).		_____ _____ Signature date
Space Launch and Transportation Systems (SLTS): SLTS#6, Design and Operations; Teaching Science and Technology, Colorado Springs, CO.; Offered at KSC, (1 week).		_____ _____ Signature date
Systems Safety Course: Solar – SMA - 066-01.		_____ _____ Signature date
Reliability Engineering (ESS, HALT and testability Analysis – Advanced), Relisoft class number 03239 or equivalent, (5 days).		_____ _____ Signature date
Weibull Analysis: RAC Class, (3 days), Http://rac.alionscience.com/rac		_____ _____ Signature date
Problem Solving and Decision Making: MSFC Organizational Development Class (3 days).		_____ _____ Signature date
Leadership/Teamwork Class Elective: To be selected by candidate with Champion and Supervisor.		_____ _____ Signature date

APPENDIX C: PDRM for Reliability and Maintainability Engineers: EXPERT Qualification Requirements

REFERENCE MATERIALS **Demonstrate comprehensive knowledge of contents as defined by the Discipline Champion**		**MENTOR SIGNATURE/ DATE COMPLETE**
NSTS 07700 Program Definition and Requirements Documents – Additional Volumes and sections to be identified by Champion.		_____ _____ Signature date
R&M MIL-STDs & Handbooks: To be defined by Champion: Added content.		_____ _____ Signature date
MSFC-HDBK-3173: Project Management and Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
SP-6105: NASA Systems Engineering Handbook (pages to be identified by Champion).		_____ _____ Signature date
NASA Reference Publication 1358: Systems Engineering "Toolbox" for Design-Oriented Engineers (pages to be identified by Champion).		_____ _____ Signature date

Notes:
1. Discipline Champion is responsible for identifying specific level of understanding required (See section 4.1).

APPENDIX C: PDRM for Reliability and Maintainability Engineers: EXPERT Qualification Requirements

ON THE JOB TRAINING **Complete the following activities in any sequence**		**SUPERVISOR SIGNATURE/ DATE COMPLETE**
Lead a team creating R&M "Checklists" in support of a NASA project or program.		_____ _____ Signature date
Lead a team conducting a FMEA/CIL in support of a NASA project or program including interfacing systems.		_____ _____ Signature date
Participate in, and contribute leadership to, a team creating a Fault Tree in support of a NASA project or program.		_____ _____ Signature date
Demonstrate understanding of the purpose of a Hazard Analysis, the ground rules used in conducting a Hazard Analysis, and how this information can be used in improving/evolving FMEA/CIL.		_____ _____ Signature date
Become a mentor for others in R&M. Guide other team members, including design team members, to understand the importance and benefits of upfront R&M efforts, to influence the design and to provide high value contribution to the program.		_____ _____ Signature date
Participate in activity to establish guidelines and processes for a stronger R&M discipline at NASA.		_____ _____ Signature date
Conduct, lead or contribute significantly to benchmarking studies within NASA, DOD and other Industries to achieve superior S&MA R&M processes.		_____ _____ Signature date
Lead or proactively participate in design reviews, and support program and project		

reviews.		_____ _____ Signature date
Obtain relevant external professional qualification (Recommended but not required).		_____ _____ Signature date
Provide leadership to professional society or inter-program or inter-center activities (e.g.: working groups defining standards, coordinating groups to achieve cross organizational standards, society committees/ subcommittees doing work to advance the discipline).		_____ _____ Signature date

Notes:
1. Candidate shall work with his/her supervisor to identify specific applicable assignments. Discipline Champion may be consulted to ensure proposed assignment shall satisfy the qualification requirements.

APPENDIX D: PDRM for Reliability and Maintainability Engineers: Application for Qualification

This application is for (Check One):

___ Entry into the PDRM Qualification process as an Apprentice;
All prerequisites have been satisfied

___ NOVICE Qualification
Appendix A is Attached and approved

___ JOURNEYMAN Qualification
Appendix B is attached and approved

___ EXPERT Qualification
Appendix C is attached and approved

Name of Candidate: _____

Organization: _____

Building/Location: _____

Phone: _____ Email: _____

Signatures:

Candidate Signature: _____ Date: _____

Discipline Champion: _____ Date: _____

Supervisor Signature: _____ Date: _____

S&MA Director: _____ Date: _____
(or designee)